DRAFT
CHARGE TO REVIEWERS

Peer Review of:

EPA's INDUSTRIAL WASTE AIR MODEL

INTRODUCTION AND BACKGROUND:

There are three programs established underneath the Resource Conservation and Recovery Act (RCRA): solid waste, hazardous waste, and underground storage tanks. The RCRA solid waste program (subtitle D waste) focuses on state and local governments as the primary planning, regulating, and implementing entities for the management of nonhazardous solid waste, such as household garbage and nonhazardous solid waste. EPA provides these state and local agencies with information and guidance to help states and the regulated community make better decisions in dealing with waste issues and to promote the use of safer units for solid waste disposal. While the EPA has developed federal criteria for some subtitle D waste (i.e., municipal solid waste landfills) there are not federal regulations covering the management of industrial wastes in industrial landfills, surface impoundments, waste piles, and land application units. The regulation of these units is the sole responsibility of states and local governments.

To assist States, local governments, and industry in developing appropriate management actions for these units, the EPA entered into a joint effort with representatives from state environmental agencies, industry, and environmental interest groups to develop a voluntary guidance for the management of industrial solid waste. The Guidance recommends developing management practices that are tailored to the risk posed by a specific unit. To enhance the quality of the analysis that will determine the appropriate management practices for a specific unit, the Guidance includes two models, one that calculates risks from the air pathway and one that recommends a liner type by evaluating the ground water pathway.

The purpose of the air model, the Industrial Waste Air Model (IWAIR), is to determine the potential risks to nearby receptors or workers that may occur as a result of volatile emissions from the waste management unit. The State, local authorities, and other interested parties would then use this information to determine if emission controls should be used for the waste management unit.

The following are four goals that IWAIR is to achieve:

1. the model should provide reasonable estimates of risk from a specific unit for the direct inhalation pathway;
2. the model should be simple enough to use that it can be run by users with different levels of technical knowledge and experience in environmental fields including members of the general public;
3. the model should be capable of running with very little data on the facility (enables the public to use it);
4. finally, the model should be flexible enough that users can enter in alternative emissions data, dispersion data, and/or toxicity benchmarks.

IWAIR contains three modeling components. The first is an emissions model that estimates the emission of specific constituents from the unit into the atmosphere. The second component of the model estimates atmospheric dispersion of constituents and ambient air concentrations at a specific receptor point. The third, the risk component of the model, combines constituent concentrations at the specified receptor point with receptor exposure factors and toxicity benchmarks to estimate risk.

<u>Emissions</u>: IWAIR incorporates the emissions model CHEMDAT8. Once a user enters data to characterize the unit and waste, CHEMDAT8 calculates the emission rate. CHEMDAT8 was developed by the EPA and has undergone extensive peer review. IWAIR allows a user to enter site-specific data for these parameters or to rely on default data to calculate emissions.

<u>Dispersion</u>: The dispersion model used in IWAIR is EPA's model Industrial Source Complex Short Term Version 3 (ISCST3). ISCST3 is a complex model and running it to develop a new dispersion factor for each site and waste management unit requires extensive meteorological data and technical expertise. In order to create an easily accessible and user-friendly modeling tool to evaluate the dispersion of air emissions, ISCST3 was previously run to generate a database of dispersion factors. The dispersion factors are included in IWAIR and have been calculated for many separate scenarios designed to cover a broad range of unit characteristics. There is a dispersion factor for each combination of:

- 29 meteorological stations, chosen to represent the nine general climate regions of the continental U.S.,
- 4 unit types,
- 14 surface area sizes for landfills, land application units and surface impoundments, and seven surface area sizes and two heights for waste piles,
- 6 receptor distances from the unit, placed in...
- 16 directions in relation to the edge of the unit.

The default dispersion factors were derived by modeling each of these scenarios, then choosing as the default the maximum dispersion factor for each waste management unit/surface area/meteorological station/receptor distance combination. Based on the size and location of a unit specified by the user, IWAIR selects an appropriate dispersion factor from these modeled scenarios. If the user specifies a unit surface area that falls between two of the sizes previously modeled, a linear interpolation method incorporated into IWAIR will estimate dispersion in relation to the two closest unit sizes.

The advantage of this approach to dispersion modeling is that IWAIR provides you with a quick, easy-to-use method to calculate dispersion. Relying directly on ISCST3 requires significant technical expertise, access to very complex and resource intensive model, and substantial amounts of data. On the other hand, a limitation of the model is the fact that it does not reflect the particular conditions of a specific location.

<u>Risk Model</u>: This component of IWAIR combines the constituent-specific emission rate with the dispersion factor to calculate a concentration in the air at a specified receptor location. IWAIR calculates adult worker or resident exposures based on inhalation, body weight, exposure duration and frequency, and ambient concentrations of constituents at a specific receptor location. Default values for these parameters are based on EPA's *Exposure Factors Handbook*. IWAIR relies on standard health benchmarks (cancer slope factors for carcinogens and reference concentrations for noncarcinogens) to calculate risk or acceptable waste constituent concentrations.

IWAIR can be used two ways. Forward calculation uses known constituent concentrations in a waste to calculate risk to receptors at specified locations. Backward calculation starts with a target risk level at a specified receptor location. The model then calculates backwards to concentration levels in waste that can be protectively managed in a unit without exceeding the target risk level.

MATERIALS OFFERED FOR REVIEW:

To be reviewed according to the charge:

EPA'S Industrial Waste Air Model (IWAIR)
Technical Background Document for IWAIR
User's Guide for IWAIR

CHARGE TO THE REVIEWERS:

The intention of this peer review is to determine if IWAIR is appropriate and meets the four goals that were listed above. Peer review is meant to ensure that science is used credibly and appropriately in the work performed. The primary function of the peer reviewer should be to judge whether the choice, use, and interpretation of data and the derivation and models used in the assessments are appropriate and scientifically sound thereby achieving the purpose that EPA intends the model to be used for.

As a reviewer of IWAIR, you should use your best technical knowledge and professional judgment to comment on the technical accuracy, completeness and scientific soundness of the model. It is also imperative that the reviewer <u>remember the goals of the model</u> when developing comments. In addition, it is extremely important to not only comment on inadequacies but to suggest a specific solution or alternative and make recommendations for improvement that will still maintain the spirit of the goals listed above. The peer review should only consider the scientific credibility of the model including applicability, uncertainty, and utility (including potential mis-use) of results, but should not advise the Agency on specific regulatory decisions or policy stemming in part from consideration of the model output.

In reviewing the software and accompanying documentation, the reviewers are requested to focus on:

1) the overall model performance;

2) specific model features;

3) the parameters used;

4) and, the quality of the software and documentation.

Specifically:

<u>I. Overall Model Performance</u>

1. Given the goals of the model, is IWAIR an appropriate tool to use? Does the model provide a reasonably accurate representation of the risk from a unit? Does the model perform well over a range of input values and scenarios? How can the model be improved?

2. A user of IWAIR is given one of two results, the risk from the unit or the concentration of a chemical that can be present in the unit to remain under a certain risk threshold. The intention of IWAIR is to provide information to the user on whether or not emission controls should be placed on a waste management unit. Are the types of results that IWAIR provides appropriate for this analysis? If not, what

results would be more appropriate for determining whether or not a waste management unit should have emission controls?

3. The Guidance recommends that facilities control particulate emissions from waste managment units. As a result, IWAIR assumes that particulate emissions are negligible and are not included as part of the modeling. In addition, IWAIR only evaluates the direct inhalation risks. Is this adequate for the chemicals considered (when answering this question, please keep in mind that there is another model for the groundwater pathway)?

II. Specific Model Features

1. Does the flexibility to change emissions rates, dispersion factors, and toxicity benchmarks make a more robust tool or diminish the accuracy of the results? Explain why. Are there other parameters in the model that the user should have the ability to override?

2. Is the modeling approach that relies on matching limited site-specific information to previously calculated dispersion factors a reasonable method to estimate dispersion of constituents from a unit? If not, how should dispersion be calculated for these waste management units if the model is to remain quick, easy to use, and not require an extensive amount of data?

3. Are the number of representative meteorological stations sufficient for assigning previously calculated dispersion factors? If not, how many should be added and where?

4. Are the assumptions made for the dispersion modeling appropriate (i.e., flat terrain, rural vs. urban, etc.)?

5. Have the boundaries surrounding a meteorological station that assign a region to a station been assigned appropriately and with a reasonable methodology? Is there a better method for assigning facilities to a meteorological station?

6. Is Chemdat8 an appropriate emissions model to use in IWAIR. Do you think that the emissions estimates calculated by Chemdat8 over predict, under predict, or provide a reasonable prediction of the emission rate from a unit?

7. Are there other tools or modeling approaches that would better serve the purpose of the location-adjusted analysis? If so, what are they?

8. ISCST3 is sensitive to the size of the area of the source. To obtain a dispersion factor for a specific waste management units surface area, an interpolation routine was used.

Is this an appropriate method for estimating the dispersion for a specific surface area? Is there a better method?

III. Parameters Used for WMU's:

1. Comment on the assumptions and parameter ranges used for in the model that are shown on the attached tables (Tables 1-4). Are the assumptions appropriate for the type of analysis? Are the parameter ranges reasonable and reflective of the range of unit characteristics and conditions encountered in real situations?

2. Comment on the default values shown on the attached tables (Tables 1-4) that are assigned to some of the key parameters. Do these defaults seem reasonable, would other default values be more appropriate? If so, what are they or where can the data be found to develop better defaults

3. Comment on the assumptions that were used in the dispersion modeling to develop the dispersion factors. Are these assumptions appropriate for developing dispersion factors around industrial facilities? If not, how should they be changed?

4. The emissions calculation performed by Chemdat8 uses either Henry's law or Raoult's law depending on whether the waste is aqueous or oily. For oily (organic wastes), the model uses Raoult's law and the liquid-to-air partition coefficient becomes proportional to the contaminant's vapor pressure. For aqueous wastes, the model uses Henry's law and the liquid-to-air partition coefficient becomes proportional to the contaminants Henry's law coefficient. The rule of thumb used in assigning which way the waste will be modeled using IWAIR is dependent on the fraction of organics in the waste. Once the user has specified the constituents in the waste, IWAIR will estimate the fraction of organics. If the waste contains more than 10% organic material then the emissions are estimated using Raoult's law. Is this rule of thumb scientifically accurate? Is there a better method of choosing which way the emissions should be modeled?

5. There are several checks in IWAIR designed to ensure that the parameters entered by a user are realistic. For example, IWAIR checks the tilling depth of a land application unit in relation to the depth of application that is calculated from inputs by the user. Please comment on all the checks in IWAIR. Do these checks capture unrealistic entries? If not, recommend an alternative.

6. IWAIR can model the risk for 95 constituents (volatiles, semi-volatiles, and mercury.) These are the chemicals that were selected by OSW to model in study, the Air Characteristic Study, that evaluated the potential direct inhalation risks from certain

waste management units. The chemicals were selected for the Air Characteristics Study based on their potential to generate a risk via the inhalation pathway. Are there other chemicals that are commonly used in industry that should be added to the list of constituents considered in IWAIR?

IV. Risk Assessment

1. IWAIR will calculate the additive risk from the carcinogens. Considering additive risk for non-carcinogens is more uncertain due to target organ/multiple organs effects. Should a means for adding together the non-carcinogens be added to IWAIR? If so, please suggest a method.

2. Are the risks appropriately characterized for the cancer and non-cancer risks?

3. Review and comment on the Newton-Raphson Method used in the back calculation approach in IWAIR. This information is contained in Section 6 of the Technical Background Document.

V. The Quality of the Software and Documentation

1. Comment on the ease-of-use and logic of IWAIR.

2. Comment on the nature of the instructions within the program. Are they clear and easy to understand?

3. Comment on the layout of the user-interface screens. Are all easy to use and read?

4. Comment on the presentation of results. Are they consistent and easy to understand?

5. Comment on the ease of installation and file manipulation (saving and retrieval?)

6. Comment on the logic and clarity of the documentation. Were any important points, assumptions missing or inadequately explained?

7. Comment on the structure of the user's guide. Is it easy to follow? Are there any inconsistencies with the software?

8. Comment on the readability of the user's guide. Can it be used by an individual without a lot of air modeling experience including members of the general public?

9. Comment on the structure of the Technical Background Document. Is the modeling approach and logic used for development clear?

10. Is there sufficient explanation concerning the structure and assumptions in the model? What else should be described?

11. Comment on the readability of the Technical Background Document. Is it written at a level appropriate for someone with some environmental training and modeling experience?

Table 1. Ranges/Default Values for Input Parameters for Landfills

Input Parameter	Units	Default Value	Min	Max	Comments
Unit Design and Operating Parameters					
Operating Life of Landfill	years	None	>0	none	
Total Area of Landfill - All Cells	m^2	None	>0	none	
Average Depth of Landfill Cell	m	None	>0	none	
Total Number of Cells in Landfill	unitless	None	>0	none	
Average Annual Quantity of Waste Disposed	Mg/yr	None	>0	none	
Waste Characterization Information					
Dry Bulk Density of Waste in Landfill	g/cm^3	1.4	>0	none	
Average Molecular Weight of Oily Waste	g/gmol	147	>0	none	
Total Porosity of Waste	volume fraction	0.50	>=0	<=1	This is a fraction, so is limited to 0-1 by definition.
Air-filled Porosity of Waste	volume fraction	0.25	>=0	<=total porosity	Max is a physical limitation.

Table 2. Ranges/Default Values for Input Parameters for Land Application Units (LAUs)

Input Parameter	Units	Default Value	Min	Max	Comments
Unit Design and Operating Parameters					
Operating Life of LAU	years	None	>0	none	
Tilling Depth of LAU	m	None	>0	none	
Surface Area of LAU	m^2	None	>0	none	
Average Annual Quantity of Waste Applied	Mg/yr	None	>0	none	
Number of Applications per Year	yr^{-1}	None	>0	none	
Waste Characterization Information					
Dry Bulk Density of Waste/Soil Mixture	g/cm^3	1.3	>0	none	
Average Molecular Weight of Oily Waste	g/gmol	282	>0	none	
Total Porosity of Waste/Soil Mixture	volume fraction	0.61	>=0	<=1	This is a fraction, so is limited to 0-1 by definition.
Air-filled Porosity of Waste/Soil	volume fraction	0.5	>=0	<=total porosity	Max is a physical limitation.

Table 3. Ranges/Default Values for Input Parameters for Wastepiles

Input Parameter	Units	Default Value	Min	Max	Comments
Unit Design and Operating Parameters					
Height of Wastepile	m	None	>0	none	
Surface Area of Wastepile	m^2	None	>0	none	
Average Annual Quantity of Waste Added to waste pile	Mg/yr	None	>0	none	
Dry Bulk Density of Waste	g/cm^3	1.4	>0	none	
Waste Characterization Information					
Average Molecular Weight of Waste	g/gmol	147	>0	none	
Total Porosity of Waste	volume fraction	0.5	>=0	<=1	This is a fraction, so is limited to 0-1 by definition.
Air-filled Porosity of Waste	volume fraction	0.25	>=0	<=total porosity	Max is a physical limitation.

Table 4. Ranges/Default Values for Input Parameters for Surface Impoundments

Input Parameter	Units	Default Value	Min	Max	Comments
Unit Design Data					
Depth of Liquid in SI	m	None	>0	none	
Surface Area of SI	m^2	None	>0	none	
Average Annual Flow Rate	m^3/yr	None	>0	none	
Aeration Data					
Fraction of Surface Area Agitated	unitless	0.25	>0	<=1	This is a fraction, so is limited to 0-1 by definition. Since it is only requested if user chooses aeration, it must be greater than 0 (0 implies no aeration).
Submerged Air Flow Rate	m^3/s	0	>0	none	
Mechanical Aeration Information					
Oxygen Transfer Rate	lb O_2/h-hp	3	>0	none	This has a very narrow range (2.9 to 3.0) and is rather obscure (i.e., user could easily not have any clue about the appropriate range). Propose including a warning if a value outside this range is entered, and the user could either cancel (and change it) or choose explicitly to proceed anyway.
Number of Aerators	unitless	1	>0	none	
Total Power Input to All Aerators	hp	75	>0	none	
Power Efficiency of Aerators	fraction	0.83	>0	<=1	Has a very narrow range (0.80 to 0.85) and is rather obscure (i.e., user could easily not have any clue about the appropriate range). Propose including a warning if a value outside this range is entered, and the user could either cancel (and change it) or choose explicitly to proceed anyway.
Aerator Impeller Diameter	cm	61	>0	none	
Aerator Impeller Rotational Speed	radians/s	130	>0	none	
Waste Characteristic Data					
Average Molecular Weight	g/gmol	282	>0	none	
Active Biomass Conc. (as MLVSS) in the SI	g/L	0.05	>=0	<=TSS	This is a subset of TSS, so cannot be greater than TSS.
Total Suspended Solids (TSS) in SI Influent	g/L	0.2	>=0	<=1,000	Cannot exceed density of waste (presumed by CHEMDAT8 to be 1 kg/L = 1,000 g/L).
Total Organics (TOC or COD) in SI Influent	mg/L	sum of chem conc entered (exclude mercury)	>=sum of chem conc entered (exclude mercury)	<=1,000,000	Must be at least as much as implied by chemical concentrations entered for waste. Cannot exceed density of waste (presumed by CHEMDAT8 to be 1 kg/L or 1,000,000 mg/L).
Degradation Rate of Total Organics	mg/g biomass-h	19	>=0	none	